[0135] The processor can be programmable to operate the detector to detect one or more polynucleotides or a probe thereof in a microfluidic cartridge located in the receiving bay.

[0136] The detector can be, for example, an optical detector. For example, the detector can include a light source that selectively emits light in an absorption band of a fluorescent dye, and a light detector that selectively detects light in an emission band of the fluorescent dye, wherein the fluorescent dye corresponds to a fluorescent polynucleotide probe or a fragment thereof. Alternatively, for example, the optical detector can include a bandpass-filtered diode that selectively emits light in the absorption band of the fluorescent dye and a bandpass filtered photodiode that selectively detects light in the emission band of the fluorescent dye; or for example, the optical detector can be configured to independently detect a plurality of fluorescent dyes having different fluorescent emission spectra, wherein each fluorescent dye corresponds to a fluorescent polynucleotide probe or a fragment thereof; or for example, the optical detector can be configured to independently detect a plurality of fluorescent dyes at a plurality of different locations on a microfluidic cartridge, wherein each fluorescent dye corresponds to a fluorescent polynucleotide probe or a fragment thereof in a different sample. The detector can also be configured to detect the presence or absence of sample in a PCR reaction chamber in a given sample lane, and to condition initiation of thermocycling upon affirmative detection of presence of the sample. Further description of suitably configured detectors are described in U.S. patent application Ser. No. _____, filed on Nov. 14, 2007 and entitled "Fluorescence Detector for Microfluidic Diagnostic System", incorporated herein by reference.

[0137] Although the various depictions therein show a heater substrate disposed underneath a microfluidic substrate, and a detector disposed on top of it, it would be understood that an inverted arrangement would work equally as well. In such an embodiment, the heater would be forced down onto the microfluidic substrate, making contact therewith, and the detector would be mounted underneath the substrate, disposed to collect light directed downwards towards it.

[0138] In various embodiments, the apparatus can further include an analysis port. The analysis port can be configured to allow an external sample analyzer to analyze a sample in the microfluidic cartridge. For example, the analysis port can be a hole or window in the apparatus which can accept an optical detection probe that can analyze a sample or progress of PCR in situ in the microfluidic cartridge. In some embodiments, the analysis port can be configured to direct a sample from the microfluidic cartridge to an external sample analyzer; for example, the analysis port can include a conduit in fluid communication with the microfluidic cartridge that directs a liquid sample containing an amplified polynucleotide to a chromatography apparatus, an optical spectrometer, a mass spectrometer, or the like.

[0139] The heat source can be, for example, a heat source such as a resistive heater or network of resistive heaters. In some embodiments, the at least one heat source can be a contact heat source selected from a resistive heater (or network thereof), a radiator, a fluidic heat exchanger and a Peltier device. The contact heat source can be configured at the receiving bay to be thermally coupled to one or more distinct locations of a microfluidic cartridge received in the receiving bay, whereby the distinct locations are selectively heated.

[0140] In various embodiments, the heat source is disposed in a heating unit that is configured to be removable from the apparatus, as further described herein.

[0141] In various embodiments, the apparatus can include a compliant layer at the contact heat source configured to thermally couple the contact heat source with at least a portion of a microfluidic cartridge received in the receiving bay. The compliant layer can have a thickness of between about 0.05 and about 2 millimeters and a Shore hardness of between about 25 and about 100.

[0142] In various embodiments, the apparatus can further include one or more force members configured to apply force to at least a portion of a microfluidic cartridge received in the receiving bay. The one or more force members are configured to apply force to thermally couple the at least one heat source to at least a portion of the microfluidic cartridge. The application of force is important to ensure consistent thermal contact between the heater wafer and the PCR reactor and microvalves in the microfluidic cartridge.

[0143] The apparatus preferably also includes a processor microprocessor circuitry, in communication with, for example, the input device and a display, that accepts a user's instructions and controls analysis of samples.

[0144] In various embodiments, the apparatus can further include at least one input device coupled to the processor, the input device being selected from the group consisting of a keyboard, a touch-sensitive surface, a microphone, and a mouse.

[0145] In various embodiments, the apparatus can further include at least one sample identifier coupled to the processor, the sample identifier being selected from an optical scanner such as an optical character reader, a bar code reader, or a radio frequency tag reader. For example, the sample identifier can be a handheld bar code reader.

[0146] In various embodiments, the apparatus can further include at least one data storage medium coupled to the processor, the medium selected from: a hard disk drive, an optical disk drive, or one or more removable storage media such as a CD-R, CD-RW, USB-drive, or flash memory card.

[0147] In various embodiments, the apparatus can further include at least one output coupled to the processor, the output being selected from a display, a printer, and a speaker, the coupling being either directly through a directly dedicated printer cable, or wirelessly, or via a network connection.

[0148] The apparatus further optionally comprises a display that communicates information to a user of the system. Such information includes but is not limited to: the current status of the system; progress of PCR thermocycling; and a warning message in case of malfunction of either system or cartridge. The display is preferably used in conjunction with an external input device as elsewhere described herein, through which a user may communicate instructions to apparatus **100**. A suitable input device may further comprise a reader of formatted electronic media, such as, but not limited to, a flash memory card, memory stick, USB-stick, CD, or floppy diskette. An input device may further comprise a security feature such as a fingerprint reader, retinal scanner, magnetic strip reader, or bar-code reader, for ensuring that a user of the system is in fact authorized to do so, according to pre-loaded identifying characteristics of authorized users. An input device may additionally—and simultaneously—function as an output device for writing data in connection with sample analysis. For example, if an input device is a reader of formatted electronic media, it may also be a writer of such